CLAIMS

What is claimed is:

1. An acoustic transducer comprising:

a frame;

a diaphragm having a substantially planar projection surface, where the diaphragm is operatively attached to the frame;

a magnet structure mounted on the frame, where the magnet structure produces a magnetic-field region; and

an electrically conductive voice coil coupled to the diaphragm and extending out of a plane of the projection surface;

where the voice coil resides at least partially in the magnetic-field region.

2. The low-profile transducer of claim 1, where the magnet structure includes a pole surface, and where a distance between the pole surface and the voice coil is substantially constant during excursions of the voice coil.

3. The low-profile transducer of claim 1, where the magnetic-field region is substantially uniform throughout an excursion region of the voice coil.

4. The low-profile transducer of claim 1, where the voice coil has a substantially flat structure in the magnetic-field region, and where a plane of the voice coil in the magnetic-field region is substantially perpendicular to a magnetic field in the magnetic-field region.

5. The low-profile transducer of claim 1, further comprising:

a fin having a first edge and an opposing second edge;

where the first edge of the fin is attached to the projection surface;

where the fin extends in a direction away from the projection surface and into the magnetic-field region; and

where the voice coil is mounted on the fin.

6. The low-profile transducer of claim 5, where the fin extends in a direction substantially perpendicular to the projection surface.

7. The low-profile transducer of claim 1, where the frame comprises a ferromagnetic material.

8. The low-profile transducer of claim 1, where the frame comprises a ferromagnetic material, and where the frame provides a return path for a magnetic field generated by the magnet structure.

9. The low-profile transducer of claim 1, where the magnet structure comprises a magnet and a portion of the frame.

10. The low-profile transducer of claim 1,

where the frame comprises a ferromagnetic material,

where the magnet structure comprises a magnet and a portion of the frame, and

where the magnetic-field region is formed between the magnet and the portion of the frame.

11. The low-profile transducer of claim 1, where the frame is non-ferromagnetic.

12. The low-profile transducer of claim 1, where the frame is non-ferromagnetic and where the magnet structure comprises a magnet and a ferromagnetic material.

13. The low-profile transducer of claim 1, where the frame has a substantially crenellated shape.

14. The low-profile transducer of claim 1, where the frame includes a groove.

15. The low-profile transducer of claim 1, where the projection surface of the diaphragm is in the shape of a rectangle.

16. The low-profile transducer of claim 1, comprising at least three voice coils and further comprising three fins, where one of the voice coils is mounted on each of the fins.

17. The low-profile transducer of claim 1, further comprising side surfaces at two or more perimeter edges of the projection surface, where the side surfaces extend out of a plane of the projection surface.

18. The low-profile transducer of claim 17, where the voice coil is mounted on a side surface.

19. The low-profile transducer of claim 17, further comprising at least one fin mounted between the two perimeter edges of the projection surface.

20. The low-profile transducer of claim 1, where the projection surface and the fin are formed from a single sheet of material.

21. The low-profile transducer of claim 20, where a 90° fold in the sheet of material is adjacent to a 180° fold in the sheet of material.

22. The low-profile transducer of claim 20, where two 90° folds in the sheet of material are adjacent to a 180° fold in the sheet of material.

23. The low-profile transducer of claim 20, where a first 90° fold in the sheet of material is adjacent to a second 90° fold and the second 90° fold is adjacent to a 180° fold in the sheet of material.

24. The low-profile transducer of claim 1, further comprising a filler material attached to the projection surface, and a second sheet of material attached to the filler material, where the filler material and the second sheet provide additional rigidity to the projection surface.

25. The low-profile transducer of claim 1, further comprising a second sheet of material attached to the projection surface.

26. The low-profile transducer of claim 1, where the projection surface of the diaphragm is operatively attached to the frame.

27. The low-profile transducer of claim 26, where the attachment is provided by a pliable surround.

28. The low-profile transducer of claim 1, further comprising a side surface connected at an angle to the projection surface, where the side surface is operatively attached to the frame.

29. The low-profile transducer of claim 28, where the attachment is provided by a pliable surround.

30. The low-profile transducer of claim 1, where the magnet structure comprises at least two stationary magnets having two magnetic-field regions.

31. The low-profile transducer of claim 1, where the magnet structure comprises an a permanent magnet and a ferromagnetic yoke structure.

32. The low-profile transducer of claim 1, where the magnet structure comprises a permanent magnet.

33. The low-profile transducer of claim 1, where the magnet structure comprises an electromagnet.

34. The low-profile transducer of claim 1, where the magnet structure comprises a material selected from the group consisting of ferrite, neodymium, strontium, samarium cobalt, mixtures of Al, Ni, and Co, and combinations thereof.

35. The low-profile transducer of claim 1, where the frame has a substantially crenellated shape, and where the magnet structure includes a magnet attached to a portion of the crenellated frame.

36. The low-profile transducer of claim 35, where the magnet is attached to the frame and oriented so that adjacent to a pole of the magnet, a magnetic field of the magnet is oriented substantially parallel to the projection surface.

37. The low-profile transducer of claim 35, where the magnet is in contact with the bottom of the frame.

38. The low-profile transducer of claim 35, where the frame comprises a groove, and where the magnet is adjacent to the groove.

39. The low-profile transducer of claim 1, where the magnet structure comprises two permanent magnets, and where the magnetic-field region is formed between opposing magnetic poles of the two permanent magnets.

40. The low-profile transducer of claim 1, where the voice coil comprises a metal selected from the group consisting of silver, gold, aluminum, copper, and mixtures thereof.

41. The low-profile transducer of claim 1, where the voice coil comprises a substantially flat ribbon of metal.

42. The low-profile transducer of claim 1, where a conductive metal is formed on the fin of the diaphragm to form the voice coil.

43. The low-profile transducer of claim 1, where the voice coil comprises an insulated metal wire.

44. A loudspeaker comprising the low-profile transducer of claim 1.

45. The loudspeaker of claim 44, further comprising at least one cone-type transducer.

46. The loudspeaker of claim 44, further comprising a crossover.

47. A low-profile transducer comprising:

a frame;

a diaphragm having at least two arched projection surfaces joined to at least one substantially flat fin, where no more than two projection surfaces are joined to a single fin;

a magnet structure mounted on the frame, where the magnet structure produces a magnetic-field region; and

an electrically conductive voice coil mounted on the fin;

where the voice coil resides at least partially in the magnetic-field region.

48. The low-profile transducer of claim 47, where the magnet structure includes a pole surface, and where a distance between the pole surface and the voice coil is substantially constant during excursions of the voice coil.

49. The low-profile transducer of claim 47, where the magnetic-field region is substantially uniform throughout an excursion region of the voice coil.

50. The low-profile transducer of claim 47, where the voice coil has a substantially flat structure in the magnetic-field region, and where a plane of the voice coil in the magnetic-field region is substantially perpendicular to a magnetic field in the magnetic-field region.

51. The low-profile transducer of claim 47, where the projection surfaces and the fin are formed from a single sheet of material.

52. The low-profile transducer of claim 51, where the sheet is folded to create the projection surfaces and the fin.

53. The low-profile transducer of claim 47, where the fin extends in a direction substantially perpendicular to the projection surface.

54. The low-profile transducer of claim 47,
where the frame comprises a ferromagnetic material,
where the magnet structure comprises a magnet and a portion of the frame, and
where the magnetic-field region is formed between the magnet and the portion of the frame.

55. The low-profile transducer of claim 47, where the frame is non-ferromagnetic and where the magnet structure comprises a magnet and a ferromagnetic material.

56. The low-profile transducer of claim 47, where the projection surface of the diaphragm is in the shape of a rectangle.

57. The low-profile transducer of claim 47, comprising at least three voice coils and further comprising three fins, where one of the voice coils is mounted on each of the fins.

58. The low-profile transducer of claim 47, further comprising a second sheet of material attached to the projection surface.

59. The low-profile transducer of claim 47, where the projection surface of the diaphragm is operatively attached to the frame by a pliable surround.

60. The low-profile transducer of claim 47, further comprising a side surface connected at an angle to the projection surface, where the side surface is operatively attached to the frame by a pliable surround.

61. The low-profile transducer of claim 47, where the magnet structure comprises an a permanent magnet and a ferromagnetic yoke structure.

62. The low-profile transducer of claim 47, where the frame has a substantially crenellated shape, and where the magnet structure includes a magnet attached to a portion of the crenellated frame.

63. A loudspeaker comprising the low-profile transducer of claim 47.

64. A method of reproducing a sound wave comprising:

supplying a time-varying electric potential to a voice coil residing in a magnetic-field region;

where the voice coil is operatively attached to a non-electrically conductive diaphragm having at least two arched elongate projection surfaces joined to at least one substantially flat elongated fin, and

where no more than two projection surfaces are joined to a single fin.

65. The method of claim 64, where at least two projection surfaces of the diaphragm are attached to a frame by a pliable surround.

66. A method of reproducing a sound wave comprising:

supplying an electric potential of changing polarity to a voice coil residing in a magnetic-field region,

where the voice coil is operatively attached to a non-electrically conductive diaphragm having a substantially planar projection surface and at least one fin, and

where the fin is substantially perpendicular to the projection surface.

67. The method of claim 66, where the diaphragm is attached to a frame by a pliable surround.

68. A low-profile transducer comprising:

a frame comprising a ferromagnetic material;

a diaphragm having a substantially planar first surface and at least one substantially elongate second surface, wherein the second surface is substantially perpendicular to the first surface;

at least one stationary magnet having a substantially elongate direct-field magnetic-gap; and

at least one substantially elongate electrically conductive voice-coil;

where the diaphragm is operatively attached to the frame, the diaphragm is non-electrically conducting, the stationary magnet is attached to the frame, the voice-coil is attached to at least one second surface of the diaphragm, and the voice-coil resides at least partially in the direct-field magnetic-gap; and

where the magnetic-gap is formed between a stationary magnet and the frame;

where the first surface and the second surface are formed from a single sheet of material;

where the sheet is folded along one dimension to create the first and second surface;

where two 90° folds the sheet are adjacent to an 180° fold; and

where the first surface of the diaphragm is operatively attached to the frame by a pliable-surround.